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ScienceDirect

Procedia Computer Science 92 (2016) 237 – 243

Procedia Computer Science

2nd International Conference on Intelligent Computing, Communication & Convergence

(ICCC-2016)

Srikanta Patnaik, Editor in Chief

Conference Organized by Interscience Institute of Management and Technology

Bhubaneswar, Odisha, India

Predicting the Impact of Climate Change on Tidal Zone Fishes Using SVM Approach

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Abstract

Climate change is the most important topic discussed among countries due to the damage it made to the environment. The impact of the climate change influences the people and marine fisheries directly and indirectly. The implication of climate change resulted into rising sea level, changes of pattern in coastal landscape, missing seasonal rainfall, tsunami etc. Rising of temperature is one such impact which affects the marine fisheries. The marine fishes are drifted from their conventional ocean zone into different places because of the absence of favorable environment. In Indian Ocean (IO), the seasonal catchments of customary fishes like sardine, pelagic and demersal are reduced due to the aberrant pattern of climate change. If the trend is continue, the problem of lack of catchment, over fishing is to be happened in the near future. This paper presents the details of these conventional fishes and analyse their decline in catchment due to climate change. Furthermore, the historical data of these fish catchment is taken for predicting the future trend. The Support Vector Machine (SVM) algorithm is employed for predicting the nature of these fishes. The system is tested with the available datasets and the test result shows the efficiency of the proposed system.

Peer-review under responsibility of the Organizing Committee of ICCC 2016

Keywords: Ocean Heat Content, Climate change, SVM.

Peer-review under responsibility of the Organizing Committee of ICCC 2016

doi:10.1016/j.procs.2016.07.351

1. Introduction

Marine ecosystem is the one of the key component of the ocean environment. India has its long coastal area and nearly 400 millions of people depend on fishing and related business. More than 70% of people are relying on sea foods because of its rich contents of protein and other minerals. Furthermore, it contains folic acid which reduces the malnutrition among children and pregnant woman. Climate change is a perennial problem in this decade for its implications greatly affects the environment and human lives. The impact of climate change includes rising of sea level, changes in weather pattern, draught, loss of monsoon, missing seasonal rainfall, incessant downpour of rain, rising temperature, changes in coastal landscape etc[1]. Marine ecosystem is greatly affected due to the climate change. The conventional fishes like sardine and pelagic drifted from one sea area to other places due to the lack favourable condition in the sea[2]. This work focuses on analyzing the impact of climate change in marine fishes and proposes a mechanism to predict the catchments of these fishes in various intervals. Tamilnadu coastal is considered for the work and landing of these fisheries data is obtained from the national and international research centres during the period 1990 to 2013.

The Ocean has the ability to soak the CO_2 (Carbon dioxide) that changes it in the bicarbonate on the interior surface of the ocean after reaction. The effect of global warming proved that there is a rise in CO_2 and green house gas [3]. The data of OHC (Oceanic Heat Content) is increasing quickly in the year of 1994-2013 shows the impact of climate change. The changes in heat content of IO and landing of marine fisheries are directly proportional to each other. Various researches prove that the heat content of northern hemisphere of Indian Ocean is always greater than the other areas [4]. Due to the Overflow of toxic gases in the environment by several organizations, machines and motors cause depletion in the ozone layer [5].

The studies prove that the temperature in the shallowest part of the ocean is lifted more than 0.1of which directs to the boost in sea level worldwide [7]. The outcome of gain in temperature guide several factors such as mass coral bleaching that result to shrinkage malnourishment, and death to thousands of variety, fish movement to poles in reaction to the drowning of wetlands, ocean warming, disastrous positive feedback loop results in abortion of solar radiation, ocean acidification due to ocean abortion and in climate change[8]. The total fishery lands in Tamil Nadu are 6.9 L Ha. Our earlier work, a QoS normalization process is used for web services discovery and ranking [10]. It also can be used for normalization process.

2. Methodology

The forecast of tendency on the hallway of sailing fishes in Tamil Nadu is produced based on the trend of Indian Ocean (IO). Projected web application is urbanized in a way, which can do analyze the upcoming 20 years from the yearly database. When the users are requesting for prediction of particular year, then the available database undergoes a logical process by accessing the data resource that is available on database. By using Support Vector Method (SVM) algorithm, the tendency of marine landing and Heat content in Tamil Nadu is expected. The yearly time series data is collected from NODC/NOAA and CMFRI. Figure 1 shows the overall process of the proposed system.

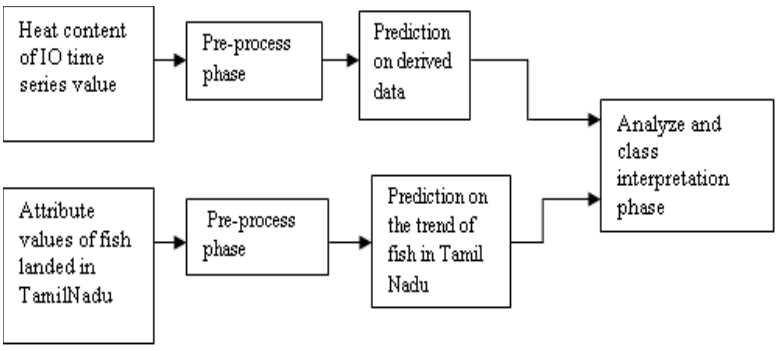

Fig.1. Over all process of prediction

2.1. Data Collection

The chronological data of last 20 year are collected by Central Marine Fisheries Research Institute (CMFRI) Government of India. Almost 80 types of fishes are landing in India. Central Marine Fisheries Research Institute (CMFRI) presents an open data access to the database on fishery landing in India. These trends are analyzed over the basin time series of heat content in Indian Ocean (IO). The data are classified as three regions of IO. They are NI, SI (Northern Hemisphere of IO and southern hemisphere of IO). These data are retrieved from NODC/NOAA[9].

2.2. Data Analysis

We have employed raw dataset on heat content of IO over a depth up to 700m. The dataset is taken into comparison with catchment details of Tamil Nadu from the historical data. It has been found that during the year of 2004, the heat content is estimated to be $1.489*10^{22}$ Joules and dropped to $-0.402*10^{22}$ joules. Similarly in catchment of marine fishes had been dropped up to 76785 tonnes in Tamil Nadu. This sudden drop and increase temperature, the habitat of fish is affected. Further study on area boundary, coastal villages and contours were obtained from the Survey of India topographic maps. Land use was collected from Institute of Remote Sensing (IRS), Anna University, Chennai, India. Tourist spots and sensitive area maps were derived from a web portal. Population data are collected from Census of India, 2001.

2.3. Prediction over Landing of Marine Fishes in Tamil Nadu

In this paper, we reconsider existing knowledge of South Pacific pelagic fisheries capital and effort to furnish some sign of probable yields for pelagic fisheries, based largely on inferences from Southeast Asia, which is nearly same. Here, fishing effort was expressed as annual adjusted fleet horsepower with all fishing vessels adjusted to the equivalent in purse seine horsepower. Such an approach may not be appropriate for South Pacific small pelagic fisheries, but something analogous is necessary. Otherwise, direct comparison of geographic and temporal trends will not be possible. Comparison, monitoring and collecting data from commercial bait catches is relatively straightforward.

3. SVM Prediction Methods

3.1. support vector machine

Support Vector Machines (SVMs) are an approved learning technique for classification, regression, and other learning process. There are many prediction methods are used to predict the fish catchment [11][12]. A typical use of Library of SVM (LIBSVM) in java has involves two steps: first, training a data set to obtain a model and second, using the model to predict information of a testing data set. Support Vector machines implement the complimented decision rules in non-linear function ϕ, which maps input points to a high-dimensional feature space where the labelled points are separable. A separating hyper plane is found, which maximizes the distance between itself and the nearest hyper plane. This distance is called the margin. Figure 2 shows the SVM flow diagram. Step involved in SVM

- Repossess the attribute values from user database.
- Exchange the attribute values into matrix layout.
- Exceed the values into svm libsvm code.
- Discover the hyper plane that enlarges the distance between classes by using SVM formulae:

$$\min \frac{1}{2}\|w\|^2 + c\sum_i \xi_i \qquad (1)$$

Subject to $y_i(w^T\phi(x_i)+b) \geq 1-\xi_i,$
$\xi_i \geq 0, i=1...l,$

- If data cannot be grouped, find the maximum and minimum margin value
- Find the average of maximum and minimum margin value of each group, Pass them to kernel function to derive the predicted value.

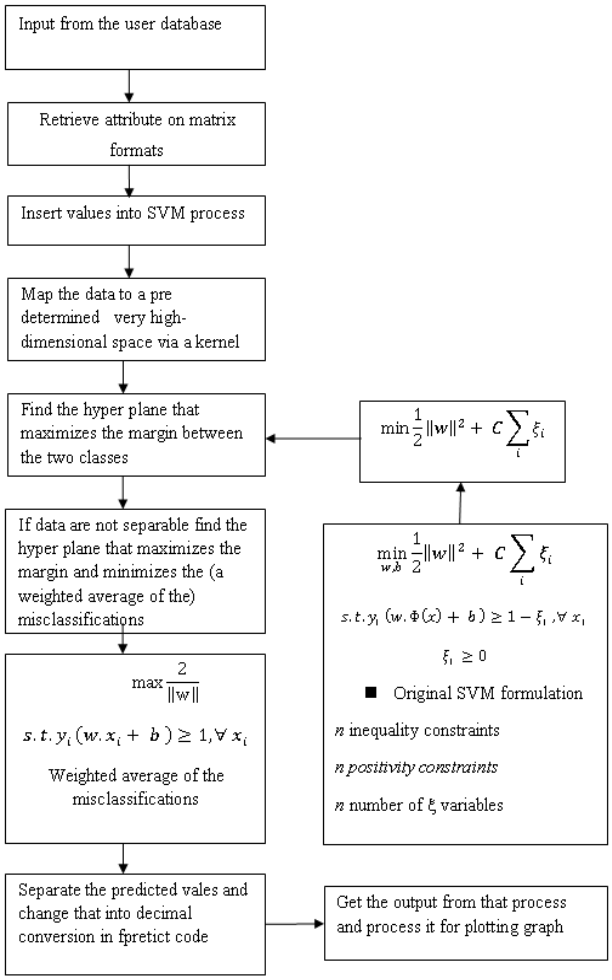

Fig 2. Flow diagram of SVM

4. Result and Analysis

Table 1 shows the actual and predicted data of fish landing during the year 1983-2011.

TABLE 1: Actual and predicted data of fish catchment (tonnes)

Actual Data				
Year	Pelagic	Demersal	Crusacean	Mollucs
1985	93030	83120	18773	5628
1986	123380	90534	22517	5610
1987	148460	117869	27232	10072
1988	142935	120834	25067	6828
1989	144365	107707	23280	5948
1990	149486	116999	26515	10275
1991	191871	124864	29687	11075
1992	206422	118241	30044	16401
1993	165567	131770	31406	8809
1994	186530	155400	43818	15749
1995	204592	160556	41306	15470
1996	226576	152482	38588	18027
1997	264015	155764	40964	11770
1998	243346	127447	43435	8394
1999	209096	116178	36133	12741
2000	222665	122857	38157	9653
2001	196650	113077	32808	8174
2002	220207	123341	40038	15080
2003	198098	107974	34723	14368
2004	211406	132537	32395	16415
2005	134621	107915	27146	10283
2006	195257	116900	35775	13841
2007	257110	128113	32078	11131
2008	234882	136216	35450	19254
2009	332756	143704	37127	20550
2010	305981	140957	35358	26739
2011	407008	156356	36840	30797

Predicted Data				
Year	Pelagics	Demersal	Crusacean	Mollucs
1985	93030	83120	18773	5628
1986	123380	90534	22517	5610
1987	148460	117869	27232	10072
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2009	332756	143704	37127	20550
2010	305981	140957	35358	26739
2011	407008	156356	36840	30797
2012	439614	167001	40322	33036
2013	433302	165844	40027	32310
2014	468060	178562	44573	35015
2015	470412	180774	44803	35537
2016	466697	179579	44166	34945
2017	473158	179095	44190	35666
2018	464842	176555	43644	34351
2019	469160	178724	45845	34396

2020	476040	183432	46461	36196
2021	466251	181955	45460	35132
2022	480050	182885	46285	36003

The proposed system is designed and it acts as fish resource management using open source software. The datasets is classified based on the format such as image and historical data. In our proposed work, Bayesian model is used to calculate the probability between the given image data sets and it gives future growth of fish resource based on the probability of image sets. Pattern mining mechanism is used to find the probability between previous year data sets and based on the results, it predicts the fish resource. The proposed system gives an efficient result.

4.1. Heat Content prediction

The predicted heat content is shown in figure 3. The X axis shows the year and y axis shows the predicted heat content in joules.

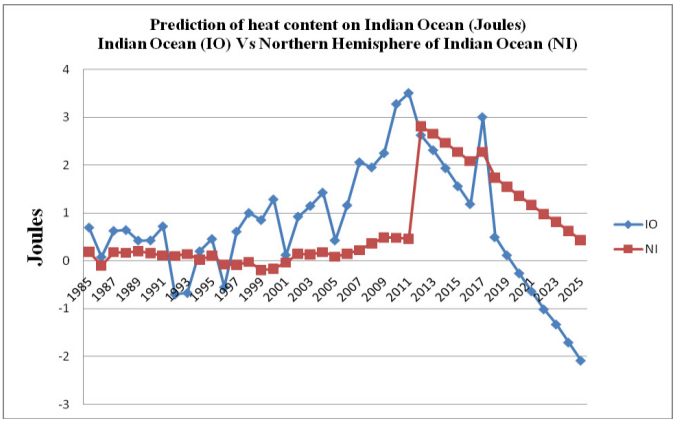

Figure 3. Prediction over heat content of IO

In figure 3, the graph showing the heat content over the series in the coastal area. This graph showing the prediction over the year-wise and it is displaying the main cause of the climate changing and global warming effect.

4.2. Fish Prediction

In Figure 4, the graph shows the predicted marine fish using SVM approach. The x axis represents the year of prediction and y axis defines the landing of fish in terms of tones.

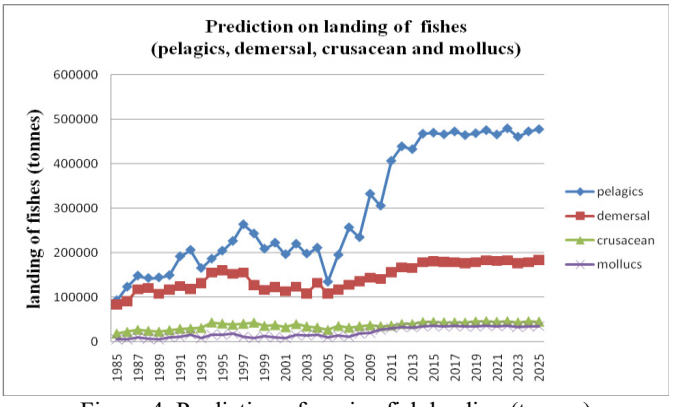

Figure 4. Prediction of marine fish landing (tonnes)

In figure 4, the above graph showing the prediction over the fish quantity per year for different fisheries landing. This prediction graph is presenting a data flow about the upcoming years based on the current situation of the environment.

Conclusion

Numerous researches prove that the coastal regions of southern India along the East part of Indian coast being affected by sea level rise. The proposed method has been developed for the prediction of climate change impacts on fishery. A statistical relation between the sea-surface temperature and fish catch has been successfully developed. A predictor that allows the prediction of the tendency (increase or decrease) of fish catch if the temperature is known has been successfully constructed. The predictor's power has also been quantitatively estimated. The result provided from the study is used for the state governments to develop the adaptation plans and appropriate policies to avoid the losses in future.

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